The Impact of Bus Rapid Transit on Location Choice of Creative Industries and Employment Density in Seoul, Korea

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Bus rapid transit (BRT) has been a promising form of public transportation due to a higher burden of rail transit construction and operation. Many urban economists and planners argue that convenient public transit is one of the core urban strategies to attract and retain creative industries and increase employment density. Although many leaders of cities in the world pay attention to the new type of public transit, we have less understanding of the BRT impact on the location choice of creative industries and job density. Through multilevel modeling, this study tests whether BRT improvement in Seoul, Korea was appealing to the spatial patterns of creative industries and if it changed the spatial variation of employment density. This study confirms that the BRT system is the favorable component for the location of creative industries and service sectors within 500 meters of BRT-bus stops. In addition, the BRT operation increases the employment density within the same distance to the bus stops by 54%. The key findings suggest that enhancing the public transit system would be an effective strategy for higher competitiveness in the urban economy and compact urban structure.

Keywords: bus rapid transit, creative industries, employment density, Seoul

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1. INTRODUCTION

A creative class has risen as the core sector of urban economic prosperity. As the global economy faces severe competition among nations and cities, innovative ideas of the creative class and their social networking determine winners and losers of the contemporary economy. Further, the creative class values a clean urban environment and a convenient urban life as cities suffer from traffic congestion and pollution. One of the critical issues is how to attract and retain a creative class and make compact cities for urban well-being while reducing carbon emission.

Public transit services help make cities sustainable and livable by relieving congestion, saving energy, conferring environmental advantages, and enhancing the mobility of minorities (Altshuler *et al.*, 1979; Dunn, 1997). For a long time, rail transit has been the dominant public transit option in urban areas. Recently, city leaders have turned their attention to bus rapid transit (hereafter, BRT). The public transit system uses buses to provide a high speed transit service which is faster than the traditional bus service. The public transit system is beneficial for the following reasons: it is cost effective in comparison to rail construction, it is adaptable to the dynamics of urban spatial structures, it has the ability to widen the service area without requiring car ownership and rail service, and it is compatible with current rail transit systems. Increasingly, BRT indicating median bus-lanes with well-organized transportation systems, has become the alternative form of rail transit. The general features of BRT include dedicated median bus lanes to allow bus operations separated from other modes of traffic, higher frequency service provisions along BRT corridors, bus priority through traffic signal treatments, and well-designed platforms with information on bus arrival time. Among them, the exclusive median bus lane represents the dedicated lane that only buses use without inference from other modes of transportation. Urban economists and planners emphasize the significance of BRT for providing efficient connectivity among creative talents and encouraging face-to-face knowledge spillover (Florida, 2002).

In spite of higher interests in the innovative BRT system, we currently have less knowledge regarding the impact of bus transit on firm location. First, while urban economists and planners argue that public transit improvements attract and retain the creative class or industries, there are few empirical tests of the link between newly emerging public investment like BRT and the location of creative industries. Second, most studies of public transit and firm geography have focused on the impact of rail transit, not on bus rapid transit because rail transit causes more remarkable effects on urban spatial structure than bus transit. As public finance suffers from chronic deficits in rail operations, many transportation authorities have decided to turn their interests to bus transit operations. Therefore, we need more empirical studies drawing on available data and sophisticated frameworks to identify the connections between bus transit and employment locations. Finally, we only have limited evidence to assess the change of employment density that follows the investment of BRT. Before-and-after studies are especially needed, that include time-series data to identify the substantial effects of bus

transit on the location and relocation choice of creative industries.

This study tests whether BRT in Seoul attracts and retains creative industries that match with Richard Florida's classification of creative class. Further, the effects of BRT on employment density were examined through multilevel regression models. For designing research and understanding the contexts of the cases, this study reviewed the related theories and empirical research and introduced BRT improvements in Seoul, Korea. The BRT improvements in Seoul that benchmarked Latin America's BRT operations include installing exclusive median bus lanes, improved transfer systems between buses and subways, an entirely integrated fare and ticketing system among modes and routes, and a traffic information system. Through the multilevel models, this study summarizes the model outputs on the effects of the BRT improvements on geography of creative industries and employment density. The conclusion suggests a few policy implications from key findings. In this study, the creative industries represent Super-Creatives and Creative Professionals by matching with Florida's classification (Table 2). The Super-Creatives include higher knowledge-based sectors with scientific and arts expertise such as professional, scientific, technical services, educational services, arts, and entertainment and recreation. Creative professionals refers to classic-knowledge based sectors including: finance and insurance, real estate, rental and leasing, health care, and social assistance.

2. LITERATURE REVIEW

Understanding the impact of transportation is a key to explaining and predicting firm geography. Urban economic theory holds that firms and households choose locations by considering rent and transportation costs (Alonso, 1964; Giuliano, 2004). To understand the relationships between transportation and firm geography, we need to consider non-transportation components as well, such as developing information technology, land-use regulation, tax policy, and homeowner politics (Fischel, 2001).

Housing and neighborhood attributes also influence household and firm location choices. Models that simultaneously account for residential and employment location decisions show that better living environments tend to spur employment growth. Among components favorable to firm location, transportation is critical because households are sensitive to options for accessing their job location (Deitz, 1998). Higher accessibility to job markets is another factor in how residents of owner-occupied houses choose neighborhoods, because commuting time is important in shaping the geographical patterns of residents and firms (Quigley, 1985).

The spatial clustering of firms generates sub-centers of jobs along main transportation corridors. This clustered location and connectivity among firms then increases employment densities at specific places. A subcenter study of Chicago confirms that easy access to airports, highway, and rail transit allows firms to concentrate at specific areas and enjoy greater economies of scale (McMillen

and McDonald, 1998). Another Chicago case study reveals that Central Business District (CBD)-oriented urban structures and main transport facilities decisively determine the location and growth of job subcenters (McMillen and Lester, 2003). In the global economy, the growth of sub-centers varies with the composition of industries and accessibility to airports, not proximity to the labor pool and highways (Giuliano and Small, 1993). A subcenter tends to locate close to, or in connection with, other sub-centers to take advantage of face-to-face information exchange and knowledge spillover (Sivitanidou, 1996).

Among forms of public transit, rail transit most remarkably changes the spatial patterns of employment as well as industrial composition, because network proximity to customers and other businesses matters most in firm geography (Bollinger and Ihlandfeldt, 1997). Further, hauling large-volume passengers in a fast and stable speed within a wide-area railroad network resulted in noticeable effects on the spatial arrangement of demography and firm geography. In terms of employment options, Washington's METRO encourages the creation of jobs and a diverse composition of industry within its transit service areas (Green and James, 1993). A BART study confirms that the shares of knowledge-based professional workers rose near BART stations, because occupations that require highly skilled workers optimize the value of face-to-face communication and access to a competitive pool of skilled workers (Cervero and Landis, 1997). The variation of rail transit impacts on employment and firm locations depends on local contexts, such as the local economy, existing employment and population densities, and travel demand.

A significant amount of literature has discussed the effects of public transit operations on land values, land use change and urban development, and intensive land use (Ryan, 1999). Transportation infrastructure provided greater accessibility for households and firms to increase the price of land around transportation nodes (Dowall and Monkkonnen, 2007). New transportation infrastructure confers the benefits of higher mobility and accessibility in property value instantaneously. In the long-term, land use would change since land development takes time to obtain permits and zoning adjustment (Paez *et al*, 2003). Limited literature focuses on the BRT impact on property market. BRT operations in Colombia appreciated the rent near multifamily housing (Rodriquez and Targa, 2004). BRT stops with better walkable environments are more likely to appreciate the land values because more amenities will attract a larger number of passengers (Estupian and Rodriguez, 2008).

Efficient connectivity among industries and fast velocity of public transit promote knowledge spillover and higher productivity. Thus, urban economists and planners pay attention to the innovative improvements of public transit such as high-speed rail, bus rapid transit, and subways (Florida, 2010). Especially, they underscore the importance of public transit in inner cities where it is easier to meet creative talents face-to-face interaction (Glaeser *et al*. 2001). The enhanced public transit, however, is not in a sufficient condition to appeal to the creative class and rising employment density. Many empirical studies emphasize a systemic and holistic approach including mixed-use development, transit-connected land use, amenity-affluent

landscapes, and social space for face-to-face interaction (Rappaport, 2009).

3. BACKGROUND INFORMATION ON BRT IN SEOUL

The Seoul Metropolitan Government needed new transportation policies to accommodate travel demand. Specifically, the bus rapid transit project had been intended to offset the reduction in traffic capacity caused by the removal of the freeway. The greenway Mayor Lee installed after removing the freeway in 2002, provides a pedestrian-friendly water corridor and places for citizen relaxation. The conversion into urban greenway, however, reduced the capacity of traffic flow. Naturally, traffic congestion had been a common concern among the related stakeholders.

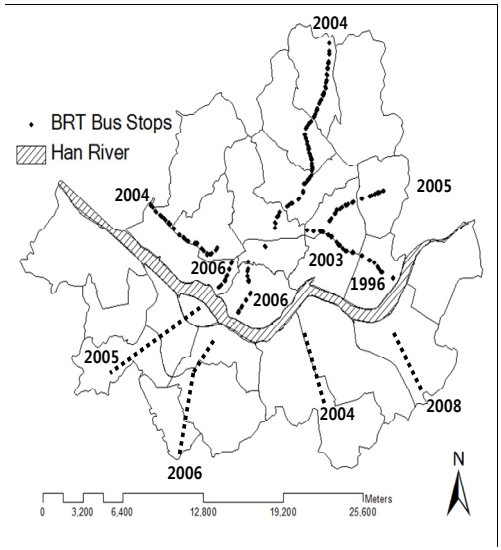
For a long time, bus transit reform has been a critical issue in Seoul. As a result of the decreasing mode share of transit and serious traffic congestion, bus transit had reformed in the mid-1990s, including the introduction of dedicated curbside bus lanes. Bus transit decline rooted in inconvenient transfers between transit modes, poor service, irregular arrivals at bus stops, and limitation in service hours (Seoul Development Institute, 2005). The chronic deficits of bus companies required more government subsidies, whose total came to 97.2 billion Korean Won (US$76 million) in 2003. Bus transit, however, still has offered mobility for citizens and economic activities.

Bus transit reform changed the interests of stakeholders such as bus companies and citizens. The BRT project faced two conflicts among the interest groups. First, bus companies opposed the introduction of BRT because it required an overall reform of bus services that would alter existing bus lines and operations. The bus companies feared their interests would be compromised. The second conflict arose on the merchants' side, as they were concerned about the alteration of existing trade zones (Song and Kim, 2005).

The overall improvements of BRT services have appeared in Seoul. On July 2004, Seoul Metropolitan Government installed dedicated median-lane services with reformed transportation system such as bus-priority signals, passenger information systems at bus stops, and higher-amenity designs and accessibility to bus stops (Figure 1). Figure 2 illustrates that Seoul had opened 74 kilometers of median-lane BRT services extending over eight corridors by 2008.

Photo Credit: Seoul Metropolitan Government

〈Figure 1〉 Bus median lanes in Seoul



Source: Adapted from Seoul Metropolitan Government

〈Figure 2〉 Map of BRT corridors in Seoul

4. RESEARCH METHODOLOGY AND DATA SOURCES

Diverse data sources were used in this study. Table 1 provides a detailed description and sources of the compiled data set from the Korean Central Government as well as the Seoul Metropolitan Government. The primary data for this study was the Annual Firm Survey (Establishments Census) for identifying industry structure and locations in Seoul from 2001 and 2006.

Due to limited data acquisition in the Firm Survey, this study focuses on the period from 2001 to 2006 to identify immediate responses after the urban greenway and BRT projects. The Annual Land Survey used in this study provides the specific address, land uses, assessed land value, and other assessed features of each parcel.

For response variables in the models, this study also compiles data regarding the classification of industry types in 2001 and 2006, and a 100-square meter grid-based employment densities. The firm location model tests whether green and transit-oriented policies attract and retain firms in creative industries that typically include providing business-to-business creative services as well as creating intellectual property such as arts and entertainment. To answer the core question, this study reclassified Korean industry sectors using Richard Florida's concept, as shown in Table 2. This matching method has the advantage of identifying the spatial patterns of creative versus noncreative industries. To estimate changes in employment densities along the CGC corridor and BRT lines, densities were calculated based on 100-square meter grid cells.

〈Table 1〉 Variable description and data source

Variables	*Description*	*Data Source*
Dependent Variables		
Industrial Types	Categorized Industry=1, Working sector=0	Annual Firm Survey
Employment Density	Number of Employment in 10 by 10 meter grid cells	Calculated using GIS
Independent Variables		
Other Location Factors(m)		
Distance to Ramp	Straight-line distance to elevated freeway ramp	Calculated using GIS
Distance to Pedestrian Entrances	Straight-line distance to pedestrian entrances on urban greenway	Calculated using GIS
Distance to CBD: City Hall	Straight-line distance to Seoul's City Hall	Calculated using GIS
Distance to Subway Stations	Straight-line distance to nearest subway stations	Calculated using GIS
Distance to Arterial Roads	Straight-line distance to arterial roads	Calculated using GIS
Distance to Bus Stops	Straight-line distance to bus stops	Calculated using GIS
Land Value and Regulation		
CPI-adjusted Land Value	Land value adjusted with CPI (2005=100)	Annual Land Survey
Building Coverage Ratio	Ratio of floor area to total land area	Seoul Zoning Map
Floor Area Ratio	Ratio of total building area to floor area	Seoul Zoning Map
Neighborhood Economic and Demographic Attributes		
Population Density	Number of population per total district area	Seoul Statistics
Employment Density	Number of employment per gross Ward area	Seoul Statistics
Age Structure	Proportion of 20~40, 40~60, and more than 60 per people more than 20 years of age	Seoul Statistics
Proportion of College Degree	Number of people with college degree per people more than 20 years of age	Population and Housing Census
Other Neighborhood Attributes		
Park Ratio	Park area per gross Ward area	Seoul Statistics
Developed Land Ratio	Land for building, school, and road per gross Ward area	Seoul Statistics
Road Area Ratio	Total road area per gross Ward area	Seoul Statistics
Retail Area Ratio	Total retail building area per gross Ward area	Seoul Statistics
Proportion of Residential Permit in Total Permit	Total area of residential permit per gross permit area	Seoul Statistics
Proportion of Commercial Permit in Total Permit	Total area of commercial permit per gross permit area	Seoul Statistics
CPI-adjusted Local Tax per Households	CPI-adjusted local tax per households (Korean Won)	Seoul Statistics

〈Table 2〉 Matching between Richard Florida's classification and Korean industry sectors

Industry Sectors	Richard Florida's Classification	Korean Industry Sectors
Working Sectors	Construction and Extraction Occupations	Construction
	Installation, Maintenance, and Repair Occupations	Other Public, Repair and Personal Service Activities
	Production Occupations	Manufacturing
	Transportation and Material Moving Occupations	Transportation
Super-Creatives	Computer and Mathematical Occupations	Professional, Scientific, and Technical Services
	Architecture and Engineering Occupations	
	Life, Physical, and Social Science Occupations	
	Education, Training, and Library Occupations	Educational Services
	Arts, Design, Entertainment, Sports, and Media Occupations	Arts, Entertainment, and Recreation
Creative Professionals	Management Occupations	Public Administration
	Business and Financial Operations Occupations	Finance and Insurance, Real Estate and Rental and Leasing
	Legal Occupations	
	Healthcare Practitioners and Technical Occupations	Health Care and Social Assistance
	High-end sales and sales management	
Services	Health Care Support Occupations	
	Food Preparation and Food-service-related Occupations	Accommodation and Food Service
	Building and Grounds Cleaning and Maintenance Occupations	Electricity, Gas and Water Supply
	Personal Care and Service Occupations	
	Low-end slales and related occupations	Wholesale and Retail Trade
	Office and administrative support occupations	Post and Telecommunications
	Community and social service occupations	
	Protective service occupations	

Sources: Florida (2002), National Statistics Office (2000)

In the models for studying the impacts of the previous curb-side bus system and the BRT improvements, the sample frame is classified based on industry sectors - Super-Creatives, Creative Professionals, and Services - whose nearest bus stops became median-lane stops once the BRT service was introduced in 2004. Thus, if a sector was closer to a median-lane bus stop than a regular bus stop, it was included for observation in the models; if it was closer to a regular bus stop, it was not.

5. LOCATION CHOICE MODELS OF CREATIVE INDUSTRIES

To explore how the BRT enhancements affected the location of Super-Creatives, Creative Professionals, and Services, this study compiled data on the firm locations of classified industries in the Annual Firm Survey and the related neighborhood attributes surrounding the firms' locations.

5.1 Model Structure

The multilevel logit model is appropriate for binary or dichotomous response variables with different levels of measurement units. Multilevel modeling accounts for the fact that classified

industries from the same neighborhood share attributes such as local transportation network designs, demographic characteristics, property markets, and public finance. Multilevel models for the location choice of creative industries take the following form: in the models, all ratio-scale variables on the right-hand side were converted to natural logarithms to estimate interpretable parameters. Non-log models show parameters too small to interpret. Working Sectors are baseline groups in multilevel binary logit models.

$$y_{ij} = \gamma_{00} + \beta_k S_{ijk} + \beta_k D_{ijk} + \beta_k N_{ijk} + \mu_{0j} + \varepsilon_{ij} \quad (1)$$

Where:

y_{ij} = 1 if classified industry i (Level 1) in neighborhood j (Level 2), 0 if Working Sectors, the neighborhoods include administrative districts and wards;

γ_{00} = model constant;

β_k = coefficient of variables (k=1, 2, 3, … m, m= number of variables)

S_{ijk} = a vector of neighborhood sociodemographic characteristics (e.g., population and employment density, educational level, and residents' age structure) for sectors in i (Level 1) in neighborhood j (Level 2);

D_{ijk} = a vector of location attributes (e.g., distance to bus stops, Cheong Gye Cheon, CBD, subway stations, and arterial roads) for sectors in i (Level 1) in neighborhood j (Level 2);

N_{ijk} = a vector of neighborhood land use (e.g., the share of parcels in retail and park use) and public revenue (e.g., local tax per household) for sectors in i (Level 1) in neighborhood j (Level 2); and

M_{0j}, ε_{ij}, = residual error terms of Level 2 and Level 1, respectively.

An important criterion of the multilevel logit model is the intraclass correlation (ICC), which indicates the relative variation in the estimated dependent variable both between and within neighborhoods (Level 2) (Statacorp, 2007). Typically ICC values more than 0.05 and with statistically significant probability levels, suggest that classified industry sectors tend to share neighborhood attributes, indicating the necessity for multilevel modeling (Rabe-Hesketh and Skrondal, 2008).

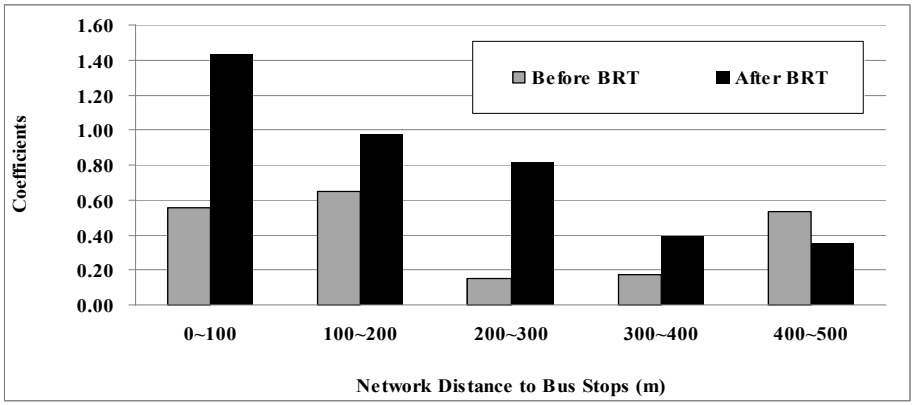
5.2 Model Results

Tables 3 to 5 reveal the multilevel model results for Super-Creatives, Creative Professionals, and Services in 2001 and 2006, respectively. Slightly better model fits were obtained when expressing ratio-scale explanatory variables in natural logarithm forms, therefore these model results are presented. Although interclass correlations (ICC) for models of Super-Creatives and Creative Services in 2001 came to less than 0.05, multilevel logit models were used to present a consistent framework. The sample frame, focusing only on firms near BRT-bus stops, might have produced the lower value of ICC. This study notes that all of the models for the location choice of creative industries are satisfied with ICCs above 0.05 in constant-only models, indicating the necessity for multilevel logit modeling (Rabe-Hesketh and Skrondal, 2008).

5.2.1 Super-Creatives models, 2001 and 2006

Figure 3 plotted the coefficients for the relative network proximity of Super-Creatives to network proximity before and after median bus lane stops were introduced. Notably, Super-Creatives' firms within 500 meters of BRT bus stops, were more likely to emerge relative to firms beyond 500 meters; when the non-BRT bus stops were in place, the location probability of the firms was weaker than the probability after BRT improvements. Clearly, the enhanced BRT service attracted and retained more Super-Creatives in 2006. Super-Creatives tend to choose sites near the enhanced bus transit services so they can enjoy the accessibility to other industries and customers.

Among other variables, Super-Creatives in 2001 were more likely to be close to the freeway ramps and subway stations. Only the location of pedestrian entrances on the urban greenway significantly influenced the location choices of Super-Creatives in 2006. Possibly, the combination of BRT bus stops and access to pedestrian entrances might have determined the geography of Super-Creatives after the BRT improvements. Higher land value was positively associated with the location choices of Super-Creatives in both periods. Super-Creatives can afford to pay higher land rent because this sector represents higher productive industries. Areas with highly educated residents in 2006 were more likely to contain Super-Creatives, and having more dwellers 40 to 60 years of age decreased the probability of the sector's emergence in 2001. These patterns tell us about the dynamic relationship among education level, age structure, and the location of Super-Creatives in the area. In the models, other neighborhoods' attributes were not statistically significant, but were retained to apply consistent sets of predictor variables across all models. The prevalence of BRT bus stops, transportation and location factors, and land value might more explain the location choices of the industry.



〈Figure 3〉 Coefficients of Super-Creatives by distance intervals

〈Table 3〉 Multilevel logit model for predicting the location of Super-Creatives

	2001			2006		
Variables	Coefficient	t	p	Coefficient	t	p
Fixed Effects						
Network Distance to Bus Stops						
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.555	3.970	0.000	1.433	10.330	0.000
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.648	5.020	0.000	0.971	7.780	0.000
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.154	1.170	0.242	0.813	6.660	0.000
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.176	1.320	0.188	0.387	3.010	0.003
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.537	3.710	0.000	0.356	2.540	0.011
Other Location Factors						
ln(Network Distance to Nearest CGC Freeway Ramps)	-1.047	-2.700	0.007			
ln(Network Distance to Nearest CGC Greenway Pedestrian Entrances)				-1.510	-4.720	0.000
ln(Distance to CBD: City Hall)	1.058	2.510	0.012	0.275	0.730	0.463
ln(Distance to Nearest Subway Stations)	-0.149	-2.980	0.003	0.000	0.000	0.997
ln(Distance to Arterial Roads)	-0.066	-1.910	0.056	0.036	0.970	0.333
Land Value						
ln(CPI-adjusted Land Value)	0.588	7.310	0.000	0.367	5.560	0.000
Neighborhood Economic and Demographic Attributes						
ln(Population Density)	0.050	0.300	0.768	0.035	0.210	0.834
ln(Employment Density)	2.415	1.600	0.109	1.921	0.700	0.483
ln(Proportion of College Degree)	0.305	1.250	0.211	0.686	1.960	0.050
ln(Proportion of 40 to 60 years old)	-6.151	-3.820	0.000	-1.361	-1.050	0.296
ln(Proportion of more than 60 years old)	1.328	1.240	0.213	-1.122	-1.770	0.076
Other Neighborhood Attributes						
ln(Park Density Ratio)	0.220	1.660	0.098	0.185	0.830	0.404
ln(Developed Land Ratio)	-0.772	-0.630	0.528	-1.814	-1.140	0.253
ln(Road Area Ratio)	-9.187	-1.720	0.085	-1.034	-0.540	0.589
ln(Retail Area Ratio)	1.110	1.510	0.130	-0.557	-0.870	0.386
ln(Proportion of Residential Permit per Total Permit)	-1.027	-1.250	0.212	-0.499	-0.630	0.530
ln(Proportion of Commercial Permit per Total Permit)	2.595	1.430	0.153	-0.849	-0.380	0.704
ln(CPI-adjusted Local Tax per Households)	-5.397	-1.760	0.079	-1.953	-1.300	0.193
Constant	33.828	1.100	0.269	5.525	0.440	0.657
Random Effects						
Standard Deviation of the Random Intercept	0.389			0.417		
ICC	0.044			0.050		
Summary Statistics						
Number of Parcel Observations (Level 1)	8,413			8,477		
Number of Neighborhood Groups (Level 2)	52			54		

5.2.2 Creative Professionals models, 2001 and 2006

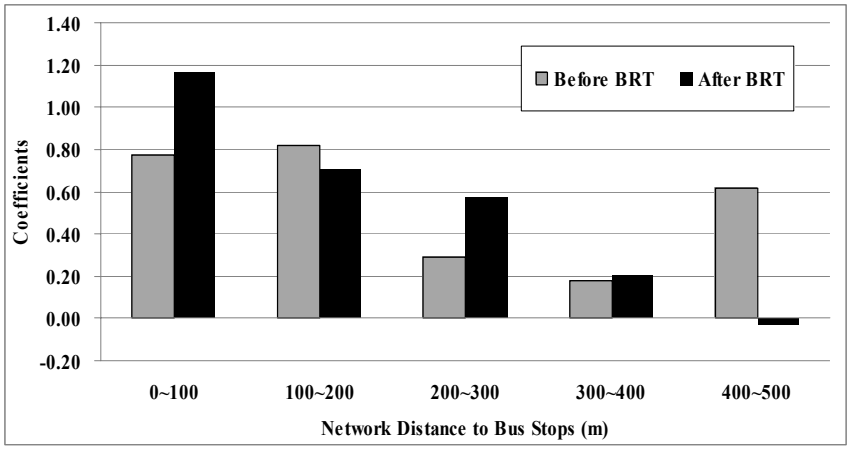
As in the Super-Creatives model, the relative network proximity to bus stops lured Creative Professionals. As plotted in Figure 4, firms of Creative Professionals located within 400 meters of the median-lane bus stops were more likely to emerge relative to firms more than 500 meters away. When bus stops were in place before the BRT improvements, the firms were more likely to be within 500 meters. However, the probability was lower than after the BRT enhancements, except in bands of 100 to 200 and 400 to 500 meters. As demonstrated by

relationships between the sector's location and bus stops, BRT service has attracted the sector along BRT corridors since 2004 compared to regular bus service.

Among other variables, Creative Professionals have a higher likelihood to gravitate towards two location components-the nearest subway stations and the pedestrian entrances on the CGC urban greenway. The transportation and amenity benefits from a world-class subway system and the emerging urban water corridor mainly determined the location of the Creative Professionals' sector.

Recalling the Super Creatives' response to land value and regulation, Creative Professionals are strongly attracted to areas with highly valued land. A reasonable interpretation is that Creative Professionals capable of producing added value occupied the higher-value land. Higher population density in 2006 was associated with a lower probability of the sectors' location in the areas, while higher employment density in 2001 spurred a greater likelihood of Creative Professionals' appearance. A higher percentage of residents 40 to 60 years of age in 2001, and older than 60 years in 2006, lowered the probability of the sector's presence in the surrounding area. The complicated relationship between neighborhood attributes and the location of Creative Professionals could reflect the dynamic change of the urban structure and transportation network during the period.

Among other neighborhood variables, road area, retail area, commercial construction permits, and local tax were significant in determining the location choices of Creative Professionals before the BRT improvements. Areas with more retail sites and commercial construction tended to attract the sector, while more road capacity and a higher local tax burden were disincentives for relocation. The outputs could indicate that some neighborhood attributes lost their appeal for Creative Professionals along the BRT corridors after the public transit reforms.



〈Figure 4〉 Coefficients of Creative Professionals by distance intervals

〈Table 4〉 Multilevel logit model for predicting the location of Creative Professionals

	2001			2006		
Variables	Coefficient	t	p	Coefficient	t	p
Fixed Effects						
Network Distance to Bus Stops						
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.771	5.070	0.000	1.166	8.120	0.000
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.818	5.780	0.000	0.710	5.540	0.000
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.287	2.000	0.046	0.571	4.540	0.000
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.179	1.200	0.231	0.204	1.530	0.126
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.619	3.800	0.000	−0.033	−0.220	0.829
Other Location Factors						
ln(Network Distance to Nearest CGC Freeway Ramps)	0.467	1.420	0.156			
ln(Network Distance to Nearest CGC Greenway Pedestrian Entrances)				−1.199	−3.300	0.001
ln(Distance to CBD: City Hall)	0.212	0.650	0.518	−0.752	−1.740	0.081
ln(Distance to Nearest Subway Stations)	−0.172	−3.260	0.001	−0.182	−3.950	0.000
ln(Distance to Arterial Roads)	−0.040	−1.100	0.273	−0.016	−0.420	0.675
Land Value						
ln(CPI-adjusted Land Value)	0.656	7.810	0.000	0.298	4.280	0.000
Neighborhood Economic and Demographic Attributes						
ln(Population Density)	0.081	0.630	0.527	−0.342	−1.990	0.047
ln(Employment Density)	3.888	3.400	0.001	−2.166	−0.710	0.478
ln(Proportion of College Degree)	0.231	1.270	0.204	0.812	1.920	0.055
ln(Proportion of 40 to 60 years old)	−4.553	−3.560	0.000	0.141	0.090	0.928
ln(Proportion of more than 60 years old)	1.347	1.600	0.110	−1.771	−2.340	0.019
Other Neighborhood Attributes						
ln(Park Density Ratio)	0.026	0.250	0.806	−0.170	−0.730	0.462
ln(Developed Land Ratio)	0.080	0.090	0.931	−0.637	−0.360	0.715
ln(Road Area Ratio)	−14.176	−3.240	0.001	1.220	0.560	0.576
ln(Retail Area Ratio)	2.285	3.710	0.000	0.227	0.300	0.761
ln(Proportion of Residential Permit per Total Permit)	−1.255	−1.880	0.061	0.526	0.600	0.552
ln(Proportion of Commercial Permit per Total Permit)	4.020	2.710	0.007	2.561	1.060	0.289
ln(CPI-adjusted Local Tax per Households)	−7.967	−3.200	0.001	−0.646	−0.380	0.701
Constant	49.393	1.980	0.048	45.507	3.170	0.002
Random Effects						
Standard Deviation of the Random Intercept	0.220			0.494		
ICC	0.015			0.069		
Summary Statistics						
Number of Parcel Observations (Level 1)	7,939			8,152		
Number of Neighborhood Groups (Level 2)	52			54		

5.2.3 Services Models, 2001 and 2006

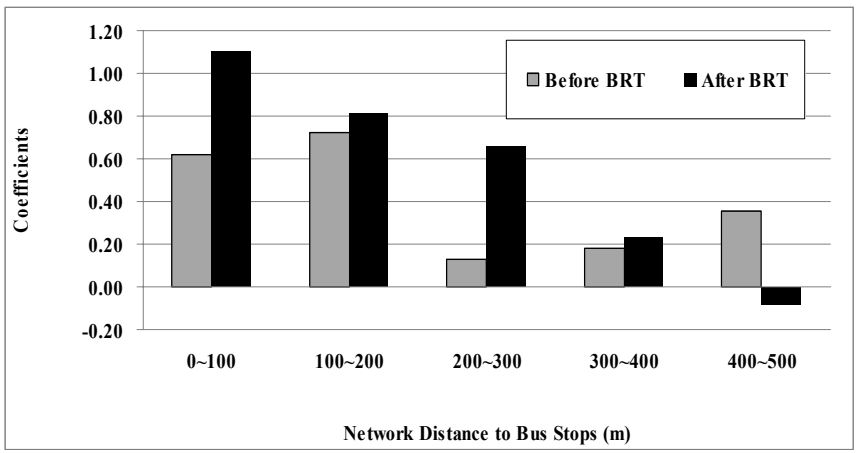
As in the previous models, the relative networks proximity to bus stops in 2006 increased the likelihood of Services' location. Figure 5 shows that the effects appeared within 400 meters of the stops. Closer proximity to bus stops in 2001 reflected a higher probability of the sector's emergence only in bands of 0 to 200 meters and 300 to 500 meters in terms of statistical significance, at a 5 percent probability level. The BRT improvements led to a higher concentration of Services closer to the bus stops. Typically, the low-skilled Services sector is more sensitive to public transit and transportation networks of inner cities, because the sector needs mobility to access customers, rather than to enjoy social interaction with other firms around urban amenities.

Among other variables, farther network distance to ramps or pedestrian entrances

lowered the probable emergence of Services in both periods. Services were more likely to be near Seoul's City Hall in 2006. This pattern shows that CBD-centered Services' locations did not change radically after the BRT reforms in 2004. Further, the sector preferred to locate near subway stations and arterial roads in 2001 and 2006. By nature, the Services sector tended to maximize access to the core of Seoul and transportation networks to approach its customers.

Higher land value tended to increase the probability of the implementation of Services' between 2001 and 2006. Further, higher employment density, and having fewer residents older than 60 years of age in the neighborhood tended to increase the probability of Services' location in 2006. This output could suggest that firms within this sector are more likely to locate near other firms, but access household customers through transportation networks. This result could show the dynamic change in urban structure and transportation networks which has occurred since 2002, rather than changes in demographic and age factors which primarily accounted for the variation of Services' location.

Among other neighborhood factors in 2001, only higher park density tended to increase the likelihood of Services' locations. After the BRT improvements, having more developed land, larger retail areas, more residential permits and construction, and a higher local tax burden, were linked with the decreased emergence of Services. More land was occupied by commercial and retail development, resulting in fewer Services in the area. In Seoul, Services mainly consist of ordinary restaurants and simple services for home goods. Thus, the sector has an inferior position in competing for land-use relative to more productive industries and higher-value residential units.



〈Figure 5〉 Coefficients of Services by distance intervals

〈Table 5〉 Multilevel logit model for predicting the location of Services

	2001			2006		
Variables	Coefficient	t	p	Coefficient	t	p
Fixed Effects						
Network Distance to Bus Stops						
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.622	7.030	0.000	1.106	12.260	0.000
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.722	8.860	0.000	0.816	10.490	0.000
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.130	1.600	0.109	0.658	8.560	0.000
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.180	2.170	0.030	0.230	2.920	0.004
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.353	3.750	0.000	-0.084	-0.930	0.354
Other Location Factors						
ln(Network Distance to Nearest CGC Freeway Ramps)	-1.370	-3.930	0.000			
ln(Network Distance to Nearest CGC Greenway Pedestrian Entrances)				-2.240	-7.900	0.000
ln(Distance to CBD: City Hall)	-0.860	-1.760	0.079	-1.307	-3.060	0.002
ln(Distance to Nearest Subway Stations)	-0.195	-5.790	0.000	-0.075	-2.440	0.015
ln(Distance to Arterial Roads)	-0.116	-4.900	0.000	-0.187	-7.980	0.000
Land Value						
ln(CPI-adjusted Land Value)	0.489	8.260	0.000	0.473	10.020	0.000
Neighborhood Economic and Demographic Attributes						
ln(Population Density)	-0.035	-0.140	0.892	-0.038	-0.190	0.853
ln(Employment Density)	2.746	1.190	0.232	9.501	2.780	0.005
ln(Proportion of College Degree)	-0.604	-1.630	0.102	0.130	0.260	0.792
ln(Proportion of 40 to 60 years old)	-1.573	-0.700	0.482	1.194	0.680	0.495
ln(Proportion of more than 60 years old)	-2.260	-1.380	0.168	-2.573	-2.950	0.003
Other Neighborhood Attributes						
ln(Park Density Ratio)	0.634	3.430	0.001	0.226	0.840	0.402
ln(Developed Land Ratio)	2.146	1.130	0.257	-3.957	-1.980	0.048
ln(Road Area Ratio)	-13.970	-1.880	0.060	-3.430	-1.300	0.192
ln(Retail Area Ratio)	0.789	0.840	0.399	-2.953	-3.530	0.000
ln(Proportion of Residential Permit per Total Permit)	-1.623	-1.410	0.160	-2.554	-2.540	0.011
ln(Proportion of Commercial Permit per Total Permit)	4.171	1.650	0.100	-4.880	-1.720	0.085
ln(CPI-adjusted Local Tax per Households)	-8.261	-1.930	0.054	-6.964	-3.870	0.000
Constant	86.537	2.050	0.040	10.695	0.640	0.522
Random Effects						
Standard Deviation of the Random Intercept	0.735			0.694		
ICC	0.141			0.128		
Summary Statistics						
Number of Parcel Observations (Level 1)	16,245			15,758		
Number of Neighborhood Groups (Level 2)	52			55		

6. EMPLOYMENT DENSITY MODELS

6.1 Model Structure

Multilevel linear regression models (MLM) are appropriate for continuous response variables with different levels of units. This approach tries to identify the effects of individual and neighborhood features for overcoming the drawbacks of ordinary least square (OLS) regression. This model allows the influence of individual and neighborhood-specific attributes to be measured using a robust statistical framework. The remarkable difference from the multilevel logit model is that the response variable is employment density with a continuous value in the earlier equation (1).

Additionally, this study estimated MLM in log-log form for two reasons: this method provides better statistical fits than linear formulations, and it moderates the effects of heteroschedastic error terms and variables with non-normal distributions. In the models that follow, all continuous-scale dependent and independent variables were converted to natural log form. A side benefit of log-log formulations is that the estimated coefficients represent elasticities, revealing the relative sensitivity of land value to changes in the right-hand-side predictor variables.

6.2 Model Results

Table 6 presents the statistical outputs from the MLM. In the table, intraclass correlations (ICC) above 0.05 justified the use of multilevel level modeling. Specifically, 53.7 and 23.1 percent of the variation of employment density is explained by between-group variation among 54 and 55 districts over the two periods, respectively.

The coefficients of the dummy variables for different network distance intervals, 100-meter bands up to 500 meters before and after the BRT bus stops, help answer the core research question-what are the relative effects of network proximity to bus stops in 2001-2004 and in 2005-2006? Figure 6 plots the marginal network distance effects of bus stops: median-lane bus stops clearly encouraged higher employment density up to a 500-meter buffer distance, while non-BRT bus stops increased the density (relative to employment grids more than 500 meters from bus stops). Specifically, lying within 100 meters of BRT bus stops increased the labor density by 54.2 percent per 100 square meters, relative to employment grids lying more than 500 meters away. The marginal effects, however, eroded with distance to the bus stops, but are still generated 500 meters away. The marginal influence of non-BRT bus stops significantly appeared only within 100 to 300 meters of non-BRT bus stops, and occurred in a range 13.8 to 24.9 percent higher than for comparable employment density lying more than 500 meters away. The enhanced services of bus transit after the BRT reforms notably spurred the concentration of employment near the stops. Such trends confirm that economic actors pursue access to higher levels of public transit to save transportation costs and to access other industries and consumers.

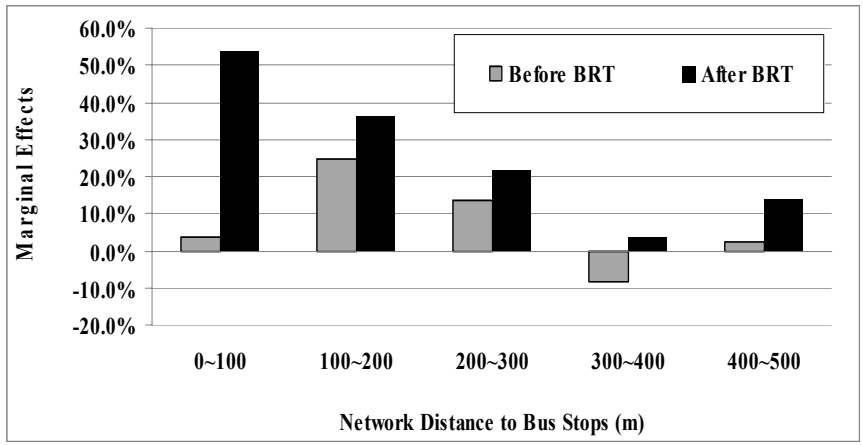
In general, employment density fell with distance to the nearest subway stations, to the CGC freeway ramps, and to the CGC urban greenway pedestrian entrances. The density increased with the distance to Seoul's City Hall in 2001-2004, but not significantly in 2005-2006. Proximity to arterial roads tended to decrease

employment density. This unreasonable relationship arose because the dependent variable is the employment density per 100 square meters, not the number of jobs at individual firms.

In both periods, higher land value was associated with the rise of employment density, because firms tend to use their land more intensively when it is valued more highly. While a higher permissible floor-area ratio is associated with employment density, a greater building coverage ratio was linked with lower employment density.

A higher population density accounted for lower employment density only in 2001-2004, and not significantly in 2005-2006, possibly because enhanced public transit better accounts for local variations in labor density. Having more residents older than 60 years of age decreased the surrounding employment density in both periods, because the age group tended to separate from the workplace. Having more dwellers 40 to 60 years of age was significant in decreasing employment density only before the BRT project. The influence of specific-age residents on the location of firms might have been reduced or eliminated after the BRT reforms.

A higher density of park land and retail area, a greater number of commercial permits, and higher local taxes were associated with lower employment density, while a higher number of residential permits tended to increase employment density only before the BRT reforms. Typically, park areas governed by strict land-use regulation were not favorable places for employment. Areas with active commercial development for stores and capital-intensive firms tended to exclude labor-intensive industries. Further, areas with higher local taxes generally correlate with better residential living environments, and also tend to push out labor-intensive manufacturers. A higher number of permits for residential housing, however, could be associated with the co-location of labor-intensive services.



〈Figure 6〉 Marginal effects of bus stops on employment density by distance intervals

〈Table 6〉 Multilevel regression models for predicting employment density

	2001~2004			2005~2006		
Variables	Coefficient	t	p	Coefficient	t	p
Fixed Effects						
Network Distance to Bus Stops						
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.036	0.560	0.577	0.542	10.230	0.000
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.249	3.930	0.000	0.363	8.340	0.000
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.138	2.220	0.027	0.217	5.140	0.000
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	-0.083	-1.230	0.217	0.038	0.850	0.393
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.024	0.310	0.754	0.141	2.900	0.004
Other Location Factors						
ln(Network Distance to Nearest CGC Freeway Ramps)	-1.393	-6.060	0.000			
ln(Network Distance to Nearest CGC Greenway Pedestrian Entrances)				-0.476	-2.270	0.023
ln(Distance to CBD: City Hall)	1.424	4.250	0.000	0.426	1.350	0.177
ln(Distance to Nearest Subway Stations)	-0.117	-6.090	0.000	-0.100	-5.140	0.000
ln(Distance to Arterial Roads)	0.073	5.900	0.000	0.121	9.220	0.000
Land Value and Regulation						
ln(CPI-adjusted Land Value)	0.465	14.690	0.000	0.345	11.370	0.000
ln(Building Coverage Ratio)	-1.063	-13.090	0.000	-1.028	-11.760	0.000
ln(Floor Area Ratio)	0.375	13.420	0.000	0.332	11.080	0.000
Neighborhood Economic and Demographic Attributes						
ln(Population Density)	-1.363	-5.760	0.000	-0.251	-1.700	0.089
ln(Proportion of College Degree)	0.159	0.350	0.727	0.220	0.640	0.523
ln(Proportion of 40 to 60 years old)	-1.864	-4.710	0.000	0.341	0.300	0.765
ln(Proportion of more than 60 years old)	-0.469	-3.030	0.002	-1.949	-3.080	0.002
Other Neighborhood Attributes						
ln(Park Density Ratio)	-0.238	-4.580	0.000	0.127	1.330	0.183
ln(Developed Land Ratio)	1.521	1.100	0.271	1.174	1.460	0.143
ln(Road Area Ratio)	-1.613	-1.160	0.244	-0.553	-0.760	0.449
ln(Retail Area Ratio)	-0.181	-2.540	0.011	0.037	0.790	0.428
ln(Proportion of Residential Permit per Total Permit)	0.359	7.020	0.000	0.001	0.020	0.983
ln(Proportion of Commercial Permit per Total Permit)	-0.310	-6.240	0.000	-0.097	-1.770	0.077
ln(CPI-adjusted Local Tax per Households)	-0.358	-2.910	0.004	0.005	0.020	0.982
Constant	5.870	1.530	0.127	-3.591	-0.690	0.489
Random Effects						
ICC	0.537			0.231		
Summary Statistics						
Number of Parcel Observations (Level 1)	15,994			11,571		
Number of Neighborhood Groups (Level 2)	54			55		

7. CONCLUSION AND POLICY IMPLICATIONS

This study confirmed that BRT improvements in Seoul clearly attracted and retained creative industries and increased employment density near BRT-bus stops since 2004. Clustering of creative industries and denser employment along BRT corridors have encouraged economic revitalization of North Seoul which suffered from constant decline of firms and households. In the multilevel models, Super-Creatives, Creative-Professionals, and Services tended to concentrate more within 500 meter to BRT-bus stops than non BRT-bus stops. Furthermore, jobs are more likely to be within 500 meter of BRT-bus stops with spatial variation. The model results suggest that BRT operations restructured the geography of creative industries and job density along BRT corridors since 2004.

Understanding the process of BRT projects and the key findings from empirical models raise a few policy implications. First, the quantitative models confirm that BRT improvements are effective strategies to make urban settings appealing to knowledge-based workers and industries. As Florida argued, the comfortable public transit service promotes face-to-face interactions among skilled workers and active knowledge spillovers. Further, the accessible transit service would enhance the residential environments of the workers. Thus, aggressive investments in public transit services would be a promising policy for the return of innovative workers and residents to central cities. Second, this study notes that overall enhancements of public transit systems, not physical change of bus lanes, generated mobility benefits to industries and residents. As we found in the related literatures on the BRT project, bus transit reforms clearly focused on bus fares, road and transit systems, management technology, and fare cards. In July 2004, the remarkable transformation in pricing was designed to integrate the fare system of bus and rail services and charge fares based on total distance traveled, not on transportation mode. The other innovation appeared in the bus management system, which offers bus-related information to in-driving buses, passengers at bus stops, and citizens using the Internet, cell phones, and PDAs. The combination of the improved transportation system and technology led to increased public transit ridership. The transit services of BRT in Seoul are still parts of the bus transit system. Considering local contexts and travel demand, BRT improvements should be expanded to include the service areas to cover Seoul City as well as Seoul Metropolitan Areas. Third, this study emphasizes the new role of public sectors and change of policy priority that focuses on public transit investment rather than investments for road expansion. For a long time, constructing automobile roads generated higher mobility of people and freight as well as greater productivity of economic activities. Automobile-centered transportation policy has been challenged due to chronic traffic congestion and serious pollution. Thus, higher public investment on transit service with green and energy-saving technology would be a critical resource to change lifestyles and urban spatial structure toward sustainable cities. Fourth, the public transit tends to encourage more transit demand based on findings in the employment density models. Seoul's BRT experience reveals that land use along BRT corridors needs to be deregulated for higher density of employment and co-location of industries. This strategy also contributes to making cities compact to reduce carbon emission causing global warming and climate change. Finally, we need a perspective of integrating firm geography with public transit plans. For a long time, we have been familiar with the separate urban plan that divides and designs each urban sector such as land use, transportation, regional economic policy, urban design, and environments. The model results in this paper show that firm and job location are considerably associated with the transportation network and level of service. Thus, we should understand the sophisticated relation between location choice of firms and transportation systems. Knowing the detailed connection between them would allow us to design relevant and effective policies for urban economic well-being and higher quality of life.

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APPENDIX

〈Table A1〉 Descriptive statistics for Super-Creatives models

	2001 (N=8,413)			2006 (N=8,477)		
Variables	Mean	Min	Max	Mean	Min	Max
Industry Type (0/1)	0.248	0	1	0.249	0	1
Network Distance to Bus Stops						
Network Distance to Bus Stops (m)	290.047	26.236	2,361.545	324.456	26.236	2,124.815
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.111	0	1	0.101	0	1
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.252	0	1	0.246	0	1
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.303	0	1	0.229	0	1
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.163	0	1	0.194	0	1
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.065	0	1	0.087	0	1
Other Location Factors						
Network Distance to Nearest CGC Freeway Ramps (m)	6,949.489	271.939	14,781.020			
Network Distance to Nearest CGC Greenway Pedestrian Entrances (m)				6,596.044	373.753	14,007.040
Distance to CBD: City Hall (Straight Line Distance, m)	7,906.076	633.323	15,230.040	8,197.871	601.273	15,190.400
Distance to Nearest Subway Stations (Straight Line Distance, m)	423.427	24.362	1,451.359	448.985	17.629	1,451.359
Distance to Arterial Roads (Straight Line Distance, m)	21.669	0.046	168.429	22.589	0.012	259.432
Land Value						
CPI-adjusted Land Value (Korean Won per Square Meter)	1,779,311	19,828	23,000,000	2,583,529	31,307	28,700,000
Neighborhood Economic and Demographic Attributes						
Population Density (Persons per Gross Square km)	26,097.150	760.714	40,346.670	27,308.530	2,103.214	46,258.500
Employment Density (Employee per Gross Square km)	4,775.818	2,272.920	34,571.180	4,687.308	2,436.440	35,385.140
Proportion of College Degree	0.110	0.037	0.271	0.170	0.085	0.339
Proportion of 20 to 40 years old	0.494	0.337	0.593	0.450	0.325	0.607
Proportion of 40 to 60 years old	0.359	0.259	0.405	0.368	0.243	0.425
Proportion of more than 60 years old	0.146	0.116	0.258	0.179	0.146	0.276
Other Neighborhood Attributes						
Park Density Ratio (Park Area per Ward Area)	0.005	0.001	0.031	0.008	0.003	0.033
Developed Land Ratio (Developed Land per Ward Area)	0.398	0.304	0.627	0.396	0.306	0.638
Road Area Ratio (Road Area per Ward Area)	0.107	0.081	0.206	0.109	0.083	0.210
Retail Area Ratio (Retail Area per Ward Area)	0.014	0.002	0.244	0.020	0.005	0.341
Proportion of Residential Permit per Total Permit	0.719	0.052	0.872	0.168	0.041	0.386
Proportion of Commercial Permit per Total Permit	0.193	0.088	0.767	0.632	0.353	0.927
CPI-adjusted Local Tax per Households (Korean Won)	1,459,932	814,963	9,590,590	1,706,826	964,945	14,200,000

〈Table A2〉 Correlation tables for Super-Creatives models

For 2001 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.206	1																				
3	dummy 300	-0.233	-0.383	1																			
4	dummy 400	-0.156	-0.257	-0.291	1																		
5	dummy 500	-0.094	-0.154	-0.174	-0.117	1																	
6	ln(Network Distance to Nearest CGC Freeway Ramps)	-0.003	-0.021	0.000	0.011	0.003	1																
7	ln(Distance to CBD: City Hall)	-0.008	0.041	-0.024	0.011	0.001	0.941	1															
8	ln(Distance to Nearest Subway Stations)	-0.020	-0.057	-0.177	0.150	0.051	0.196	0.162	1														
9	ln(Distance to Arterial Roads)	-0.085	-0.100	0.070	0.052	-0.023	-0.073	-0.036	-0.060	1													
10	ln(CPI-adjusted Land Value)	0.054	0.085	0.102	-0.102	-0.070	-0.573	-0.565	-0.307	0.065	1												
11	ln(Population Density)	-0.004	-0.009	-0.098	0.055	0.059	0.352	0.450	0.047	-0.006	-0.308	1											
12	ln(Employment Density)	0.063	0.018	-0.021	-0.036	-0.016	-0.775	-0.719	-0.092	0.057	0.558	-0.409	1										
13	ln(Proportion of College Degree)	0.055	0.011	0.077	-0.161	-0.001	-0.224	-0.277	-0.002	0.014	0.140	0.0337	0.290	1									
14	ln(Proportion of 40 to 60 years old)	-0.042	0.016	0.197	-0.049	-0.039	0.186	0.236	0.036	0.022	-0.021	-0.2148	-0.160	-0.38	1								
15	ln(Proportion of more than 60 years old)	0.032	0.038	-0.019	0.025	-0.025	-0.701	-0.738	0.005	-0.047	0.416	-0.5615	0.508	0.0131	0.1406	1							
16	ln(Park Density Ratio)	0.061	-0.049	0.128	-0.018	-0.066	-0.193	-0.171	0.056	0.142	0.369	-0.2872	0.646	0.1088	0.1079	0.0839	1						
17	ln(Developed Land Ratio)	0.035	0.120	-0.119	-0.060	0.015	-0.642	-0.545	-0.106	0.035	0.343	-0.1235	0.749	0.3988	-0.4238	0.3778	0.2582	1					
18	ln(Road Area Ratio)	0.041	0.066	-0.062	-0.059	-0.003	-0.555	-0.443	-0.070	0.058	0.424	-0.2481	0.893	0.2273	-0.1725	0.2644	0.6116	0.8302	1				
19	ln(Retail Area Ratio)	0.006	0.036	-0.015	-0.007	-0.002	-0.901	-0.813	-0.134	0.073	0.579	-0.3564	0.913	0.2407	-0.0934	0.6057	0.4432	0.7715	0.7925	1			
20	ln(Proportion of Residential Permit per Total Permit)	-0.032	0.013	-0.064	0.014	0.023	0.752	0.706	0.096	-0.061	-0.599	0.4935	-0.935	-0.1768	-0.0353	-0.5622	-0.6377	-0.5887	-0.784	-0.8655	1		
21	ln(Proportion of Commercial Permit per Total Permit)	0.093	-0.087	0.116	-0.122	-0.020	-0.275	-0.305	0.065	0.046	0.326	-0.4783	0.717	0.338	0.0957	0.2018	0.7859	0.2984	0.626	0.4717	-0.7009	1	
22	ln(CPI-adjusted Local Tax per Households)	0.067	-0.087	0.118	-0.061	-0.021	-0.671	-0.7113	-0.027	0.046	0.516	-0.5523	0.829	0.3578	0.0572	0.5618	0.6329	0.3845	0.5474	0.737	-0.8614	0.8301	1

For 2006 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.192	1																				
3	dummy 300	-0.183	-0.311	1																			
4	dummy 400	-0.164	-0.280	-0.267	1																		
5	dummy 500	-0.104	-0.176	-0.168	-0.151	1																	
6	ln(Network Distance to Greenway Pedestrian Entrances)	-0.089	-0.019	-0.089	0.153	0.054	1																
7	ln(Distance to CBD: City Hall)	-0.055	0.032	-0.103	0.161	0.028	0.907	1															
8	ln(Distance to Nearest Subway Stations)	-0.164	-0.235	0.001	0.171	0.070	0.217	0.165	1														
9	ln(Distance to Arterial Roads)	0.028	-0.064	-0.102	0.059	-0.043	-0.002	0.027	-0.002	1													
10	ln(CPI-adjusted Land Value)	0.179	0.160	0.080	-0.123	-0.092	-0.459	-0.475	-0.388	-0.007	1												
11	ln(Population Density)	-0.045	0.046	-0.113	0.040	-0.001	0.250	0.390	-0.034	-0.047	-0.202	1											
12	ln(Employment Density)	0.087	-0.036	0.045	-0.051	-0.041	-0.769	-0.715	-0.045	0.096	0.388	-0.399	1										
13	ln(Proportion of College Degree)	0.014	-0.071	0.007	-0.058	0.010	-0.283	-0.383	0.058	-0.015	0.092	-0.059	0.294	1									
14	ln(Proportion of 40 to 60 years old)	-0.057	0.032	0.019	0.058	0.050	0.391	0.456	0.049	0.065	-0.152	-0.104	-0.236	-0.578	1								
15	ln(Proportion of more than 60 years old)	0.048	0.008	0.074	0.000	-0.034	-0.409	-0.490	0.051	-0.032	0.195	-0.314	0.277	0.127	-0.045	1							
16	ln(Park Density Ratio)	0.083	0.034	0.073	0.039	-0.064	-0.226	-0.151	-0.085	0.084	0.307	-0.236	0.451	-0.405	0.254	-0.055	1						
17	ln(Developed Land Ratio)	0.068	-0.029	-0.001	-0.060	-0.037	-0.676	-0.529	-0.024	0.063	0.194	-0.058	0.692	0.477	-0.456	0.206	0.007	1					
18	ln(Road Area Ratio)	0.041	-0.046	0.001	-0.015	-0.030	-0.570	-0.403	0.020	0.136	0.199	-0.212	0.836	0.242	-0.130	0.075	0.340	0.834	1				
19	ln(Retail Area Ratio)	0.049	-0.032	0.056	-0.024	-0.020	-0.700	-0.595	-0.039	0.100	0.341	-0.363	0.948	0.192	-0.066	0.281	0.428	0.695	0.884	1			
20	ln(Proportion of Residential Permit per Total Permit)	0.081	0.074	-0.039	-0.152	-0.064	-0.359	-0.238	-0.160	-0.051	0.001	0.121	-0.026	0.131	-0.515	0.018	-0.286	0.446	0.117	-0.112	1		
21	ln(Proportion of Commercial Permit per Total Permit)	-0.007	0.008	0.020	0.087	0.001	0.256	0.220	0.018	0.029	0.091	-0.065	0.122	-0.418	0.441	-0.182	0.652	-0.500	-0.065	0.130	-0.764	1	
22	ln(CPI-adjusted Local Tax per Households)	0.072	-0.066	0.073	-0.054	-0.021	-0.765	-0.838	-0.029	0.068	0.418	-0.477	0.868	0.425	-0.266	0.435	0.269	0.487	0.522	0.760	-0.138	0.051	1

〈Table A3〉 Descriptive statistics for Creative Professionals models

	2001 (N=7,939)			2006 (N=8,152)		
Variables	Mean	Min	Max	Mean	Min	Max
Industry Type (0/1)	0.203	0	1	0.219	0	1
Network Distance to Bus Stops						
Network Distance to Bus Stops (m)	289.784	29.886	2,361.545	330.710	22.097	2,124.815
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.112	0	1	0.098	0	1
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.250	0	1	0.242	0	1
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.308	0	1	0.227	0	1
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.161	0	1	0.196	0	1
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.064	0	1	0.087	0	1
Other Location Factors						
Network Distance to Ramps (m)	7,044.289	271.939	14,781.020			
Network Distance to Pedestrian Entrances (m)				6,656.132	373.753	14,059.000
Distance to CBD: City Hall (Straight Line Distance, m)	7,984.426	633.323	15,230.040	8,245.909	601.273	15,190.400
Distance to Nearest Subway Stations (Straight Line Distance, m)	425.627	24.362	1,443.297	446.103	17.629	1,443.297
Distance to Arterial Roads (Straight Line Distance, m)	21.874	0.046	168.429	22.702	0.012	259.432
Land Value						
CPI-adjusted Land Value (Korean Won per Square Meter)	1,784,899	19,828	23,000,000	2,567,119	34,078	28,700,000
Neighborhood Economic and Demographic Attributes						
Population Density (Persons per Gross Square km)	26,155.370	760.714	40,346.670	27,487.760	2,103.214	46,258.500
Employment Density (Employee per Gross Square km)	4,703.327	2,272.920	34,571.180	4,657.190	2,436.440	35,385.140
Proportion of College Degree	0.109	0.037	0.271	0.169	0.085	0.339
Proportion of 20 to 40 years old	0.493	0.337	0.593	0.450	0.325	0.607
Proportion of 40 to 60 years old	0.360	0.259	0.405	0.368	0.243	0.425
Proportion of more than 60 years old	0.146	0.116	0.258	0.179	0.146	0.276
Other Neighborhood Attributes						
Park Density Ratio (Park Area per Ward Area)	0.005	0.001	0.031	0.008	0.003	0.033
Developed Land Ratio (Developed Land per Ward Area)	0.396	0.304	0.627	0.394	0.306	0.638
Road Area Ratio (Road Area per Ward Area)	0.107	0.081	0.206	0.109	0.083	0.210
Retail Area Ratio (Retail Area per Ward Area)	0.014	0.002	0.244	0.020	0.005	0.341
Proportion of Residential Permit per Total Permit	0.723	0.052	0.872	0.168	0.041	0.386
Proportion of Commercial Permit per Total Permit	0.192	0.088	0.767	0.632	0.353	0.927
CPI-adjusted Local Tax per Households (Korean Won)	1,716,737	976,361	11,500,000	1,684,736	964,945	14,200,000

〈Table A4〉 Correlation tables for Creative Professionals models

For 2001 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.205	1																				
3	dummy 300	-0.237	-0.386	1																			
4	dummy 400	-0.155	-0.253	-0.292	1																		
5	dummy 500	-0.093	-0.151	-0.175	-0.115	1																	
6	ln(Network Distance to Nearest CGC Freeway Ramps)	-0.004	-0.004	-0.028	0.022	0.010	1																
7	ln(Distance to CBD: City Hall)	-0.006	0.053	-0.054	0.028	0.011	0.940	1															
8	ln(Distance to Nearest Subway Stations)	-0.036	-0.077	-0.172	0.156	0.084	0.201	0.161	1														
9	ln(Distance to Arterial Roads)	-0.099	-0.110	0.067	0.069	-0.015	-0.080	-0.040	-0.046	1													
10	ln(CPI-adjusted Land Value)	0.052	0.090	0.113	-0.125	-0.069	-0.579	-0.569	-0.312	0.069	1												
11	ln(Population Density)	0.002	-0.025	-0.094	0.080	0.049	0.339	0.443	0.030	-0.009	-0.294	1											
12	ln(Employment Density)	0.066	-0.003	0.010	-0.065	-0.012	-0.771	-0.719	-0.090	0.067	0.568	-0.399	1										
13	ln(Proportion of College Degree)	0.054	0.005	0.090	-0.179	-0.010	-0.209	-0.256	0.021	0.019	0.116	0.062	0.274	1									
14	ln(Proportion of 40 to 60 years old)	-0.054	0.020	0.199	-0.047	-0.019	0.175	0.216	0.037	0.028	0.008	-0.222	-0.150	-0.358	1								
15	ln(Proportion of more than 60 years old)	0.029	0.030	-0.001	0.007	-0.018	-0.700	-0.741	0.001	-0.049	0.421	-0.557	0.501	0.002	0.141	1							
16	ln(Park Density Ratio)	0.062	-0.065	0.148	-0.049	-0.049	-0.175	-0.156	0.065	0.150	0.366	-0.272	0.635	0.087	0.142	0.065	1						
17	ln(Developed Land Ratio)	0.039	0.103	-0.092	-0.079	0.010	-0.648	-0.551	-0.118	0.037	0.356	-0.120	0.753	0.404	-0.427	0.379	0.248	1					
18	ln(Road Area Ratio)	0.047	0.046	-0.036	-0.084	0.003	-0.563	-0.456	-0.078	0.066	0.446	-0.247	0.903	0.237	-0.184	0.258	0.615	0.827	1				
19	ln(Retail Area Ratio)	0.007	0.016	0.017	-0.030	0.001	-0.900	-0.814	-0.133	0.085	0.586	-0.340	0.911	0.230	-0.086	0.598	0.432	0.777	0.798	1			
20	ln(Proportion of Residential Permit per Total Permit)	-0.031	0.029	-0.096	0.043	0.021	0.750	0.713	0.091	-0.074	-0.615	0.485	-0.935	-0.168	-0.039	-0.553	-0.633	-0.587	-0.787	-0.862	1		
21	ln(Proportion of Commercial Permit per Total Permit)	0.100	-0.097	0.133	-0.158	-0.009	-0.251	-0.289	0.085	0.057	0.322	-0.475	0.706	0.318	0.122	0.189	0.782	0.293	0.636	0.455	-0.696	1	
22	ln(CPI-adjusted Local Tax per Households)	0.068	-0.101	0.148	-0.095	-0.017	-0.662	-0.708	-0.006	0.060	0.518	-0.547	0.830	0.332	0.093	0.563	0.628	0.396	0.571	0.736	-0.871	0.824	1

For 2006 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.186	1																				
3	dummy 300	-0.179	-0.307	1																			
4	dummy 400	-0.162	-0.279	-0.268	1																		
5	dummy 500	-0.101	-0.174	-0.167	-0.152	1																	
6	ln(Network Distance to Greenway Pedestrian Entrances)	-0.083	-0.017	-0.090	0.157	0.054	1																
7	ln(Distance to CBD: City Hall)	-0.053	0.038	-0.103	0.159	0.027	0.911	1															
8	ln(Distance to Nearest Subway Stations)	-0.189	-0.235	-0.006	0.179	0.080	0.205	0.150	1														
9	ln(Distance to Arterial Roads)	0.007	-0.062	-0.103	0.055	-0.042	0.015	0.040	0.000	1													
10	ln(CPI-adjusted Land Value)	0.182	0.157	0.080	-0.120	-0.087	-0.462	-0.470	-0.387	-0.007	1												
11	ln(Population Density)	-0.057	0.075	-0.118	0.037	0.000	0.248	0.390	-0.050	-0.046	-0.197	1											
12	ln(Employment Density)	0.075	-0.050	0.060	-0.053	-0.036	-0.764	-0.720	-0.030	0.088	0.395	-0.412	1										
13	ln(Proportion of College Degree)	0.020	-0.085	0.009	-0.063	0.013	-0.270	-0.358	0.079	-0.010	0.054	-0.046	0.282	1									
14	ln(Proportion of 40 to 60 years old)	-0.058	0.014	0.033	0.077	0.045	0.380	0.427	0.043	0.071	-0.108	-0.132	-0.204	-0.559	1								
15	ln(Proportion of more than 60 years old)	0.054	-0.013	0.075	0.015	-0.023	-0.426	-0.513	0.065	-0.039	0.217	-0.325	0.302	0.131	-0.061	1							
16	ln(Park Density Ratio)	0.072	0.035	0.082	0.034	-0.062	-0.225	-0.152	-0.079	0.073	0.312	-0.232	0.451	-0.445	0.310	-0.024	1						
17	ln(Developed Land Ratio)	0.057	-0.028	0.004	-0.071	-0.037	-0.681	-0.540	-0.014	0.059	0.201	-0.057	0.694	0.502	-0.461	0.212	-0.004	1					
18	ln(Road Area Ratio)	0.030	-0.051	0.014	-0.023	-0.032	-0.580	-0.428	0.028	0.136	0.224	-0.231	0.852	0.268	-0.129	0.088	0.346	0.830	1				
19	ln(Retail Area Ratio)	0.040	-0.047	0.074	-0.022	-0.019	-0.706	-0.619	-0.028	0.093	0.369	-0.378	0.957	0.204	-0.060	0.299	0.439	0.691	0.885	1			
20	ln(Proportion of Residential Permit per Total Permit)	0.069	0.095	-0.052	-0.168	-0.064	-0.339	-0.216	-0.153	-0.066	-0.026	0.136	-0.057	0.131	-0.531	0.003	-0.313	0.429	0.091	-0.139	1		
21	ln(Proportion of Commercial Permit per Total Permit)	-0.009	-0.001	0.031	0.093	0.004	0.249	0.209	0.011	0.031	0.107	-0.081	0.132	-0.437	0.469	-0.163	0.663	-0.497	-0.053	0.142	-0.769	1	
22	ln(CPI-adjusted Local Tax per Households)	0.069	-0.090	0.085	-0.048	-0.012	-0.767	-0.844	-0.011	0.063	0.415	-0.487	0.877	0.401	-0.229	0.471	0.265	0.517	0.567	0.795	-0.161	0.053	1

〈Table A5〉 Descriptive statistics for Services models

	2001 (N=16,245)			2006 (N=15,758)		
Variables	Mean	Min	Max	Mean	Min	Max
Industry Type (0/1)	0.610	0	1	0.596	0	1
Network Distance to Bus Stops						
Network Distance to Bus Stops (m)	268.749	26.236	2,361.545	291.936	22.097	2,124.815
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.130	0	1	0.124	0	1
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.298	0	1	0.277	0	1
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.275	0	1	0.247	0	1
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.144	0	1	0.168	0	1
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.061	0	1	0.066	0	1
Other Location Factors						
Network Distance to Ramps (m)	6,722.878	271.939	14,781.020			
Network Distance to Pedestrian Entrances (m)				6,226.208	373.753	14,054.540
Distance to CBD: City Hall (Straight Line Distance, m)	7,723.444	633.323	15,230.040	7,871.712	601.273	15,190.400
Distance to Nearest Subway Stations (Straight Line Distance, m)	406.582	24.362	1,443.297	415.271	17.629	1,443.297
Distance to Arterial Roads (Straight Line Distance, m)	20.365	0.012	168.429	20.686	0.009	259.432
Land Value						
CPI-adjusted Land Value (Korean Won per Square Meter)	1,948,694	19,828	23,000,000	2,905,875	34,078	28,700,000
Neighborhood Economic and Demographic Attributes						
Population Density (Persons per Gross Square km)	25,873.300	760.714	40,346.670	26,809.510	2,103.214	46,258.500
Employment Density (Employee per Gross Square km)	4,735.757	2,272.920	34,571.180	4,732.456	2,436.440	35,385.140
Proportion of College Degree	0.110	0.037	0.271	0.171	0.085	0.339
Proportion of 20 to 40 years old	0.494	0.337	0.593	0.452	0.325	0.607
Proportion of 40 to 60 years old	0.358	0.259	0.405	0.366	0.243	0.425
Proportion of more than 60 years old	0.146	0.116	0.258	0.179	0.146	0.276
Other Neighborhood Attributes						
Park Density Ratio (Park Area per Ward Area)	0.005	0.001	0.031	0.008	0.003	0.033
Developed Land Ratio (Developed Land per Ward Area)	0.404	0.304	0.627	0.401	0.306	0.638
Road Area Ratio (Road Area per Ward Area)	0.108	0.081	0.206	0.110	0.083	0.210
Retail Area Ratio (Retail Area per Ward Area)	0.013	0.002	0.244	0.020	0.005	0.341
Proportion of Residential Permit per Total Permit	0.719	0.052	0.872	0.176	0.041	0.386
Proportion of Commercial Permit per Total Permit	0.187	0.088	0.767	0.625	0.353	0.927
CPI-adjusted Local Tax per Households (Korean Won)	1,704,262	976,361	11,500,000	1,717,849	964,945	14,200,000

〈Table A6〉 Correlation tables for Services models

For 2001 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.252	1																				
3	dummy 300	-0.239	-0.401	1																			
4	dummy 400	-0.159	-0.267	-0.253	1																		
5	dummy 500	-0.098	-0.165	-0.157	-0.104	1																	
6	ln(Network Distance to Nearest CGC Freeway Ramps)	-0.007	0.009	-0.023	0.023	0.004	1																
7	ln(Distance to CBD: City Hall)	0.007	0.069	-0.062	0.010	0.014	0.927	1															
8	ln(Distance to Nearest Subway Stations)	-0.061	-0.057	-0.131	0.151	0.066	0.219	0.171	1														
9	ln(Distance to Arterial Roads)	-0.068	-0.055	0.017	0.073	0.008	-0.087	-0.040	-0.026	1													
10	ln(CPI-adjusted Land Value)	0.075	0.094	0.074	-0.125	-0.072	-0.554	-0.524	-0.369	0.089	1												
11	ln(Population Density)	0.029	-0.016	-0.095	0.029	0.065	0.261	0.393	-0.036	-0.059	-0.248	1											
12	ln(Employment Density)	0.079	-0.007	-0.016	-0.031	-0.005	-0.773	-0.695	-0.107	0.060	0.546	-0.308	1										
13	ln(Proportion of College Degree)	0.046	-0.015	0.069	-0.096	-0.018	-0.251	-0.316	0.020	-0.036	0.130	0.045	0.279	1									
14	ln(Proportion of 40 to 60 years old)	-0.059	0.084	0.135	-0.080	-0.009	0.209	0.278	0.075	0.027	-0.080	-0.164	-0.199	-0.412	1								
15	ln(Proportion of more than 60 years old)	0.015	0.034	0.020	-0.020	-0.054	-0.675	-0.712	-0.028	0.004	0.405	-0.515	0.469	0.029	0.127	1							
16	ln(Park Density Ratio)	0.071	-0.029	0.069	0.005	-0.038	-0.197	-0.186	0.060	0.093	0.357	-0.229	0.659	0.126	-0.049	0.044	1						
17	ln(Developed Land Ratio)	0.065	0.047	-0.094	-0.055	0.010	-0.633	-0.523	-0.173	0.009	0.373	-0.026	0.751	0.362	-0.422	0.356	0.287	1					
18	ln(Road Area Ratio)	0.071	0.030	-0.057	-0.053	0.016	-0.541	-0.402	-0.096	0.053	0.435	-0.150	0.883	0.178	-0.176	0.230	0.614	0.832	1				
19	ln(Retail Area Ratio)	0.015	0.004	-0.002	-0.020	0.011	-0.893	-0.793	-0.134	0.071	0.541	-0.252	0.913	0.249	-0.118	0.565	0.438	0.765	0.783	1			
20	ln(Proportion of Residential Permit per Total Permit)	-0.056	0.021	-0.062	0.024	0.024	0.744	0.682	0.102	-0.082	-0.578	0.414	-0.929	-0.164	0.000	-0.536	-0.622	-0.582	-0.771	-0.854	1		
21	ln(Proportion of Commercial Permit per Total Permit)	0.104	-0.076	0.081	-0.076	-0.003	-0.294	-0.313	0.071	0.032	0.308	-0.434	0.728	0.295	0.022	0.188	0.784	0.313	0.620	0.490	-0.707	1	
22	ln(CPI-adjusted Local Tax per Households)	0.065	-0.082	0.102	-0.039	-0.019	-0.669	-0.711	-0.013	0.040	0.456	-0.481	0.812	0.359	-0.021	0.530	0.613	0.365	0.500	0.728	-0.841	0.826	1

For 2006 Model

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	dummy 100	1																					
2	dummy 200	-0.233	1																				
3	dummy 300	-0.216	-0.355	1																			
4	dummy 400	-0.169	-0.279	-0.258	1																		
5	dummy 500	-0.101	-0.165	-0.153	-0.120	1																	
6	ln(Network Distance to Nearest CGC Greenway Pedestrian Entrances)	-0.095	0.016	-0.044	0.099	0.045	1																
7	ln(Distance to CBD: City Hall)	-0.035	0.058	-0.076	0.099	0.026	0.884	1															
8	ln(Distance to Nearest Subway Stations)	-0.157	-0.163	-0.005	0.163	0.060	0.228	0.152	1														
9	ln(Distance to Arterial Roads)	0.040	-0.050	-0.092	0.040	-0.015	-0.049	-0.002	0.014	1													
10	ln(CPI-adjusted Land Value)	0.162	0.105	0.056	-0.106	-0.096	-0.499	-0.497	-0.386	0.007	1												
11	ln(Population Density)	0.003	0.022	-0.103	0.002	0.017	0.206	0.371	-0.081	-0.037	-0.229	1											
12	ln(Employment Density)	0.092	-0.039	-0.008	-0.009	-0.027	-0.784	-0.716	-0.061	0.100	0.423	-0.362	1										
13	ln(Proportion of College Degree)	0.007	-0.083	0.002	-0.035	0.025	-0.264	-0.406	0.054	-0.002	0.108	-0.076	0.269	1									
14	ln(Proportion of 40 to 60 years old)	-0.053	0.079	0.011	0.036	0.037	0.344	0.455	0.054	0.035	-0.207	-0.072	-0.224	-0.589	1								
15	ln(Proportion of more than 60 years old)	0.039	0.019	0.077	-0.040	-0.032	-0.415	-0.492	0.005	-0.057	0.200	-0.290	0.259	0.120	0.010	1							
16	ln(Park Density Ratio)	0.034	0.022	0.054	0.090	-0.066	-0.219	-0.172	-0.033	0.039	0.306	-0.243	0.466	-0.332	0.133	-0.101	1						
17	ln(Developed Land Ratio)	0.114	-0.046	-0.056	-0.049	-0.031	-0.669	-0.527	-0.077	0.059	0.263	-0.008	0.693	0.448	-0.459	0.177	0.022	1					
18	ln(Road Area Ratio)	0.086	-0.046	-0.053	0.010	-0.023	-0.584	-0.394	-0.015	0.127	0.255	-0.159	0.829	0.193	-0.121	0.054	0.346	0.834	1				
19	ln(Retail Area Ratio)	0.076	-0.032	0.002	-0.001	-0.009	-0.715	-0.584	-0.056	0.111	0.368	-0.320	0.941	0.142	-0.031	0.271	0.412	0.682	0.877	1			
20	ln(Proportion of Residential Permit per Total Permit)	0.092	0.030	-0.053	-0.116	-0.065	-0.327	-0.207	-0.164	-0.034	0.052	0.155	-0.027	0.142	-0.487	0.027	-0.290	0.452	0.130	-0.117	1		
21	ln(Proportion of Commercial Permit per Total Permit)	-0.046	0.026	0.040	0.099	0.005	0.236	0.212	0.057	0.011	0.046	-0.108	0.108	-0.421	0.409	-0.185	0.674	-0.502	-0.081	0.120	-0.760	1	
22	ln(CPI-adjusted Local Tax per Households)	0.051	-0.058	0.028	-0.017	-0.004	-0.764	-0.841	-0.033	0.081	0.418	-0.443	0.859	0.418	-0.244	0.414	0.269	0.470	0.494	0.740	-0.145	0.038	1

〈Table A7〉 Descriptive statistics for employment density models

	2001~2004 (N=15,994)			2005~2006 (N=11,571)		
Variables	Mean	Min	Max	Mean	Min	Max
Employment Density per 100 Square Meter	19.974	1	4,866.000	13.277	1	5,498.000
Network Distance to Bus Stops						
Network Distance to Bus Stops (m)	305.255	22.097	2,361.545	305.910	22.097	2,129.276
dummy (1, if Network Distance ≤ 100m, otherwise 0)	0.698	0	1	0.092	0	1
dummy (1, if 100 < Network Distance ≤ 200m, otherwise 0)	0.083	0	1	0.250	0	1
dummy (1, if 200 < Network Distance ≤ 300m, otherwise 0)	0.092	0	1	0.273	0	1
dummy (1, if 300 < Network Distance ≤ 400m, otherwise 0)	0.056	0	1	0.168	0	1
dummy (1, if 400 < Network Distance ≤ 500m, otherwise 0)	0.031	0	1	0.086	0	1
Other Location Factors						
Network Distance to Nearest CGC Freeway Ramps (m)	6,679.992	271.939	14,821.210			
Network Distance to Nearest CGC Greenway Pedestrian Entrances (m)				6,559.396	373.753	14,059.000
Distance to CBD: City Hall (Straight Line Distance, m)	7,493.795	601.273	15,230.040	7,912.608	601.273	15,190.400
Distance to Nearest Subway Stations (Straight Line Distance, m)	435.675	20.022	1,451.359	442.683	17.629	1,451.359
Distance to Arterial Roads (Straight Line Distance, m)	18.573	0.009	259.432	17.736	0.009	259.432
Land Value and Regulation						
CPI-adjusted Land Value (Korean Won per Square Meter)	1,760,012	15,483	24,700,000	2,227,846	31,073	28,700,000
Building Coverage Ratio	0.571	0.2	0.6	0.574	0.2	0.6
Floor Area Ratio	3.239	0.5	10	3.196	0.5	10
Neighborhood Economic and Demographic Attributes						
Population Density (Persons per Gross Square km)	25,956.290	724.762	40,346.670	26,857.860	1,951.310	46,258.500
Proportion of College Degree	0.118	0.037	0.271	0.172	0.085	0.339
Proportion of 20 to 40 years old	0.479	0.319	0.611	0.453	0.325	0.610
Proportion of 40 to 60 years old	0.358	0.245	0.409	0.367	0.243	0.425
Proportion of more than 60 years old	0.161	0.116	0.273	0.177	0.139	0.276
Other Neighborhood Attributes						
Park Density Ratio (Park Area per Ward Area)	0.005	0.001	0.033	0.007	0.002	0.033
Developed Land Ratio (Developed Land per Ward Area)	0.394	0.304	0.627	0.375	0.306	0.638
Road Area Ratio (Road Area per Ward Area)	0.104	0.081	0.210	0.100	0.083	0.210
Retail Area Ratio (Retail Area per Ward Area)	0.012	0.002	0.298	0.013	0.002	0.341
Proportion of Residential Permit per Total Permit	0.437	0.020	0.872	0.192	0.041	0.418
Proportion of Commercial Permit per Total Permit	0.386	0.083	0.951	0.512	0.050	0.927
CPI-adjusted Local Tax per Households (Korean Won)	1,651,196	814,963	12,700,000	1,574,940	940,085	13,800,000

〈Table A8〉 Correlation tables for employment density models

Correlation Table for 2001 to 2004 Models

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	dummy 100	1																						
2	dummy 200	-0.199	1																					
3	dummy 300	-0.199	-0.353	1																				
4	dummy 400	-0.147	-0.260	-0.260	1																			
5	dummy 500	-0.104	-0.183	-0.183	-0.135	1																		
6	ln(Network Distance to Nearest CGC Freeway Ramps)	-0.068	-0.020	0.061	0.019	0.0039	1																	
7	ln(Distance to CBD: City Hall)	-0.060	0.008	0.070	0.027	-0.0056	0.9416	1																
8	ln(Distance to Nearest Subway Stations)	-0.063	-0.090	-0.025	0.049	0.0154	0.2127	0.1726	1															
9	ln(Distance to Arterial Roads)	0.027	0.006	-0.043	-0.019	0.0044	-0.081	-0.0727	-0.0604	1														
10	ln(CPI-adjusted Land Value)	0.141	0.146	0.005	-0.044	-0.0859	-0.4992	-0.4823	-0.3087	0.0179	1													
11	ln(Building Coverage Ratio)	-0.041	-0.015	0.036	0.060	0.0334	-0.0778	-0.0712	-0.0681	-0.107	0.2658	1												
12	ln(Floor Area Ratio)	0.172	0.137	0.019	-0.053	-0.1013	-0.2745	-0.212	-0.293	0.1028	0.5457	0.381	1											
13	ln(Population Density)	-0.043	-0.016	-0.025	-0.004	0.0264	0.0915	0.2245	-0.0516	-0.0935	-0.1458	0.0337	-0.1636	1										
14	ln(Proportion of College Degree)	0.094	0.020	-0.051	-0.026	-0.0133	-0.3645	-0.4036	-0.0272	-0.0017	0.1983	-0.0103	0.0337	0.1162	1									
15	ln(Proportion of 40 to 60 years old)	-0.027	0.050	0.076	0.000	-0.0139	0.4735	0.5225	0.0775	-0.0107	-0.1621	-0.0306	0.0789	-0.1375	-0.4467	1								
16	ln(Proportion of more than 60 years old)	0.078	0.090	-0.044	-0.060	-0.0082	-0.4375	-0.4846	0.008	0.0257	0.2324	-0.0696	0.1393	-0.3138	0.1565	-0.062	1							
17	ln(Park Density Ratio)	0.031	0.046	0.054	0.065	-0.0715	-0.069	-0.0488	0.0452	0.0821	0.2797	0.0538	0.136	-0.1424	0.0028	0.125	-0.0471	1						
18	ln(Developed Land Ratio)	0.049	0.010	-0.087	-0.052	0.0124	-0.6388	-0.5613	-0.0897	0.106	0.2088	-0.0113	0.1516	0.0621	0.3802	-0.4358	0.2608	-0.0893	1					
19	ln(Road Area Ratio)	0.019	0.008	-0.055	-0.008	-0.0252	-0.3939	-0.3173	-0.0059	0.1297	0.2256	0.0313	0.2151	-0.0915	0.2022	-0.1253	0.0352	0.2979	0.748	1				
20	ln(Retail Area Ratio)	0.057	-0.012	-0.059	-0.009	-0.0029	-0.6673	-0.6	-0.0453	0.1254	0.3431	0.0273	0.2435	-0.0788	0.4563	-0.2332	0.2055	0.2448	0.7562	0.8089	1			
21	ln(Proportion of Residential Permit per Total Permit)	0.015	0.010	-0.055	-0.043	0.0177	0.0134	0.0277	-0.0585	-0.0055	-0.2415	-0.0479	-0.0968	0.0611	-0.082	-0.2466	-0.0498	-0.5322	0.099	-0.1779	-0.2776	1		
22	ln(Proportion of Commercial Permit per Total Permit)	-0.035	-0.002	0.071	0.057	-0.0304	0.2728	0.2678	0.0925	-0.0284	0.1013	0.0516	0.021	-0.069	-0.1271	0.3408	-0.0756	0.5643	-0.4965	-0.0528	-0.0674	-0.6821	1	
23	ln(CPI-adjusted Local Tax per Households)	0.085	0.004	-0.033	0.009	-0.019	-0.6196	-0.6551	-0.0289	0.1114	0.4051	0.0315	0.1962	-0.3421	0.4182	-0.2575	0.2563	0.4515	0.2701	0.3753	0.7013	-0.3167	0.2041	1

Correlation Table for 2005 to 2006 Models

Number	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	dummy 100	1																						
2	dummy 200	-0.184	1																					
3	dummy 300	-0.195	-0.354	1																				
4	dummy 400	-0.143	-0.259	-0.275	1																			
5	dummy 500	-0.098	-0.178	-0.189	-0.138	1																		
6	ln(Network Distance to Nearest CGC Greenway Entrances)	-0.072	-0.018	0.069	0.012	0.011	1																	
7	ln(Distance to CBD: City Hall)	-0.062	0.010	0.082	0.021	0.004	0.938	1																
8	ln(Distance to Nearest Subway Stations)	-0.080	-0.105	-0.025	0.042	0.032	0.209	0.164	1															
9	ln(Distance to Arterial Roads)	0.046	0.013	-0.044	-0.036	-0.007	-0.081	-0.072	-0.075	1														
10	ln(CPI-adjusted Land Value)	0.185	0.146	-0.003	-0.064	-0.106	-0.506	-0.500	-0.321	0.055	1													
11	ln(Building Coverage Ratio)	-0.037	-0.018	0.040	0.081	0.039	-0.075	-0.072	-0.066	-0.100	0.182	1												
12	ln(Floor Area Ratio)	0.181	0.113	0.015	-0.046	-0.088	-0.266	-0.220	-0.299	0.095	0.528	0.357	1											
13	ln(Population Density)	-0.045	-0.018	-0.021	-0.008	0.031	0.089	0.228	-0.023	-0.063	-0.228	0.003	-0.199	1										
14	ln(Proportion of College Degree)	0.093	-0.016	-0.074	-0.037	0.012	-0.362	-0.431	-0.046	0.066	0.192	-0.037	0.033	-0.008	1									
15	ln(Proportion of 40 to 60 years old)	-0.042	0.031	0.080	0.011	-0.008	0.482	0.545	0.052	-0.025	-0.186	-0.004	0.049	-0.145	-0.576	1								
16	ln(Proportion of more than 60 years old)	0.091	0.103	-0.060	-0.063	-0.021	-0.452	-0.490	0.042	0.008	0.239	-0.084	0.146	-0.219	0.185	-0.134	1							
17	ln(Park Density Ratio)	0.014	0.039	0.061	0.088	-0.061	-0.082	-0.016	-0.024	0.034	0.238	0.054	0.129	-0.122	-0.367	0.266	-0.104	1						
18	ln(Developed Land Ratio)	0.058	-0.025	-0.090	-0.046	0.017	-0.659	-0.603	-0.051	0.108	0.264	-0.007	0.160	0.033	0.560	-0.439	0.339	-0.292	1					
19	ln(Road Area Ratio)	0.034	-0.037	-0.069	-0.007	-0.012	-0.450	-0.423	0.031	0.128	0.258	0.023	0.196	-0.155	0.374	-0.124	0.150	0.095	0.760	1				
20	ln(Retail Area Ratio)	0.054	-0.023	-0.051	0.000	-0.015	-0.518	-0.522	0.014	0.120	0.363	0.021	0.213	-0.245	0.412	-0.116	0.269	0.177	0.627	0.825	1			
21	ln(Proportion of Residential Permit per Total Permit)	0.001	0.019	-0.036	-0.035	0.015	0.009	0.019	-0.059	-0.019	-0.102	0.003	-0.065	-0.003	-0.053	-0.213	-0.071	-0.285	-0.035	-0.176	-0.396	1		
22	ln(Proportion of Commercial Permit per Total Permit)	-0.025	0.011	0.047	0.049	-0.035	0.269	0.269	0.056	-0.012	0.056	0.030	0.005	-0.121	-0.297	0.383	-0.172	0.580	-0.505	-0.049	0.195	-0.244	1	
23	ln(CPI-adjusted Local Tax per Households)	0.087	-0.007	-0.067	0.000	-0.016	-0.741	-0.796	-0.051	0.112	0.454	0.031	0.202	-0.310	0.504	-0.393	0.320	0.221	0.464	0.498	0.693	-0.203	0.020	1